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PSYCHOLOGICAL AND ORGANIZATIONAL IMPLICATIONS OF COMPUTER-MEDIATED WORK

Shoshanah Zuboff

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Center for Information Systems Research

Sloan School of Management

Massachusetts Institute of Technology

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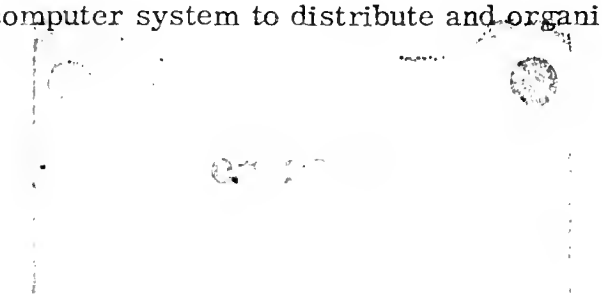
Thomas Lindstrom is a commercial airline pilot. He was selected for the job because of his intelligence, physical strength, and mental stamina -- characteristics that are critical to the complex and varied decisions a pilot must make during every minute of flight time. But lately, Lindstrom's job just isn't the same. He is now required to monitor a set of computer controls that automatically makes all flight decisions. On a good flight, he shouldn't have to do a thing. Lindstrom is bored--and angry. Thousands of dollars were invested in his training, but he is now expected to babysit a control panel.

Gerry Alvarez is a bill collector working in the headquarters of a large discount store chain. He has been a collector for more than ten years and takes a certain amount of pride in his ability to recoup cash for the company. "You get to know your accounts, and you learn how to handle them." He has learned to master various techniques for cajoling people to pay up. But lately his job just isn't the same. The firm has adopted a computer system to distribute and organize



collections activities. While the system allows for a greater volume of transactions, it takes most of the skill requirements out of the job. The computer randomly distributes accounts among the collectors, and the greater volume assures that "you can't get to know any account in depth. The computer tells you which account to work, and you can't keep an overview of your accounts because the file is automatically updated each day." Gerry wants to quit his job. He thinks the pressure is too great and the only way to get the supervisors off his back is to key in work he has not completed. He also feels that anyone can now do the job; being a "good collector" no longer makes a difference.

Linda Winthrop is a data analyst in the commercial planning department of a large bank. She spends her days accessing information from a central data bank and plugging it into various forecasting models that serve as the strategic basis for critical marketing and credit decisions. Linda does not let on but she has little or no trust in the system upon which she must depend for most of her information. There are the technical kinks--her data is sometimes mutilated or it disappears entirely--yet even when things run smoothly she does not trust that all the proper calculations are being performed on her numbers. She keeps parallel records and often repeats calculations manually before she uses them for a report. It takes a lot of extra time, but this way she feels in control of the information.

Nellie Weymouth was a linotype operator until recently when her job was altered. Instead of working that big print-forming contraption with all the crafty judgments it required, she now works at a computer terminal where she types information into a visual display unit. As far as Nellie and her co-workers are concerned, the difference between hot and cold type is that, "one has no blood and doesn't really need people at all." The main preoccupation they share each long night as the paper is printed for morning circulation is--"what can we do to bring the system down, how can we make something go wrong? After all, the rest of the fun is mostly gone."

Tom, Gerry, Linda, and Nellie are supporting actors in a drama of national proportions. That drama involves the adaptation of computer-based information technology to jobs in all parts of the labor market and at all levels of the organizational hierarchy. In some cases information systems provide technical support for a range of professional and managerial activities. In other instances, computers are applied directly to production, and work becomes computer-mediated, i.e. jobs are reformulated so that people execute their work through the medium of information technology. There are often good reasons for firms to subject their employees to this conversion to computer-mediated work activities. They include increasing productivity, expanding markets, enhancing services or products, improving the management

of complexity. But there are likely to be social and psychological implications that have not, as yet, received much systematic attention. In part, this is because there is a tendency to view information technology as just another step in a long line of technical innovations in the workplace. But this attitude overlooks some of the most significant features of the new landscape at work. Based on recent field work in several large organizations, this paper will identify four areas where implications for the psychology of work, management, and the quality of organizational life have emerged.

* * * * * *

1. Direct Experience, Individual Judgment, and Information Technology

The intent of the intellectual technology at the core of a computer system is to substitute algorithms or decision rules for individual judgment. This makes it possible to formalize the skills and know-how intrinsic to a job and integrate them into the computer program. This process is at work in the newly computerized job of the airline pilot or the bill collector cited above. As decision rules become more explicit, they are, theoretically, subject to more deliberate planning. But the more activities become planned in advance and concretized in an automated process, the less they require actual decision making at each stage of execution. As a consequence, what was once a decision is not exactly a decision any longer. Instead it is a working out of information according to rules that are specified and embedded in a computer program. Managers and employees may be called upon to monitor such "decisions," as Simon [1] has suggested, but the real risk lies in the prospect of decisions becoming increasingly analytic and insulated from any confrontation with the true complexities of the situations they are designed to govern.

This aspect of information systems can have an effect on the quality of planning at the senior management level, on the psychology of professional work, and on the job satisfaction of white collar "production"

workers. For example, when senior managers work with computer-based models of economic activity without having full access to the theoretical biases built into the program, forecasts based on such complex planning models can become self-fulfilling prophecies, dictating actions in response to rational assessments of how a diverse set of variables should interact. At the same time, a reliance on such models can limit the type of information that managers seek. As one staff analyst in a corporate planning department put it: "The sophistication of the computer model makes it the focus of the planning process. Rarely has top management thought through the issues creatively enough to critique our models. They tend to short circuit the creative envisionary process--the model becomes the only thing that happens and the vision never takes place." In such situations thinking can become so formal that it is not related to the concrete, often messy and ambiguous situations that a manager is trying to understand. The computer program and the assumptions it embodies dictate the kind of input that is relevant and assess its value. The demands of the information system thus come to define the questions that are posed, the problems that are tackled, the meaning of valid information, and eventually the limits of knowledge itself.

As the use of computer applications moves up the organizational hierarchy, managers and professional staff are often wary of systems that seem to encroach upon their judgment, their freedom, or the "art"

of their professional assessments. For example, one bank installed an information system that could make many of the routine credit calculations for the analysts in the department. The bank's technologists saw the system as one that freed the analyst from the most mechanical aspects of the job. Six months after the system was in place, not one of the twenty analysts in the department had ever used it. They perceived it as encroaching upon an important part of their "brain" work. As one analyst explained it: "I think, then I write down my calculations directly. I know the firm and the problem. With this system, I am supposed to type into the machine and let it think. Why should I let it do my thinking for me?"

Managers and professionals often resist having their work interface with computer-based information systems for reasons involving questions of status associated with typing into computer terminals, the loss of personal secretaries, the lack of understanding of the systems' capabilities, or the fear that their contribution will come to seem less important and even dispensable. Resistance to becoming committed users will increase if the information system is perceived to limit their freedom or increase the measurability of their work. At present most professionals and managers function in fairly ambiguous environments. Information is imperfectly exchanged (often in corridors, washrooms, or over lunch), and there is usually considerable lag time before the quality of decisions can be assessed.

For the manager who functions in the context of a continual flow of complete information, much of this ambiguity is reduced. For example, in the marketing area of one bank, an information system was developed that could provide complete profiles of all accounts while assessing their profitability according to key corporate criteria. Top management and systems developers believed the system could serve as a constant source of feedback to account officers, helping them to manage their account activities and maximize fee-based revenues. But the marketing professionals steadily resisted utilizing the system. The flow of "perfect" information, in reducing ambiguity, was also seen as limiting their opportunities for creative decisions.

The uncertainty of limited information may lend itself to errors of judgment, but it also provides a "free space" for actions that feel inspired. This free space is fundamental to the psychology of professional work--it is the reason that most people would prefer being professionals to assembly-line workers. Account officers perceived the information system as encroaching upon a primary source of their job satisfaction. These professionals have traditionally been motivated by the chance to display their artistry as bankers, but the "art" in their jobs is reduced as increased information organizes the context of their work.

Though information systems can be designed to either serve or replace judgment, these choices have frequently not been confronted explicitly. Managers often assume that the less dependence upon human intervention, the better the work will be executed. In many cases, including those of the airline pilot, the collections worker, and the linotype operator, the skills that people have cultivated for a lifetime are no longer depended upon or are treated as failsafe systems. When skills are no longer needed, especially in those situations where the computer system is already experienced as vast or incomprehensible, people begin to feel insignificant and overwhelmed. This situation can exacerbate the issues of power and powerlessness that haunt all levels of organizational life.

What happens when a group of people are suddenly made to feel powerless and undervalued because of the introduction of computer technology to their jobs? First there are the obvious problems of morale and motivation. If employees depend upon the computer system in order to accomplish their work, but the system is experienced as an enemy, then the quality of the work must suffer. As one office worker said "When a person makes a mistake with a computer, to try and get that mistake corrected is so much red tape. So you tend to let it go. Maybe when they see how bad the information is, they'll give us back the jobs."

The desire to retain some control over the job can take many forms. It can also generate a variety of hidden costs for the organization. Employees on a highly computerized newspaper printing operation took a gleeful pride in systems breakdowns and looked for ways to demonstrate the inefficacy of "intelligent" equipment. Outsmarting the system became the most challenging aspect of the job. Linda Winthrop, the data analyst, sought to retain some sense of control over her job by reworking most calculations by hand. This meant that turning out a report took almost twice as long as it should have. She put her situation this way: "There's a machine out there somewhere and my numbers go God knows where...I don't feel that I really know the data unless I can get my hands on it, so I have to rework it manually."

Collections workers who lost control over the work process could only retrieve some sense of mastery by keying fictitious data into the system of account files. Their managers were confronted with high productivity figures that were not matched by the size of monthly revenues. As one collector put it: "People get so discouraged because the work keeps flowing into your terminal, no matter how much you finish. The only way to deal with it is to fake some work. How else can we keep our heads above water?"

The first response of many managers to such a situation is to look for ways to increase control over the work process, but the more they attempt to control the process, the more employees will search out ways to subvert that control and gain some personal sense of mastery. Very often these subversive activities are dismissed as "resistance to change." But in many cases resistance is the only available means for employees to articulate their responses to the substance of the changes they are faced with.

Because systems planning and design can be highly centralized activities managed by a small group of experts, any single user is likely to have little or no understanding of the comprehensive functioning of the system or the decision rules and normative criteria built into programs. It becomes difficult to challenge information without understanding how it was generated, especially when there are no independent experiential reference points for judging its validity. This kind of psychological dynamic insulates information from the kind of debate and confrontation that insures its quality. It also works to preserve the authority of those who actually design the system and develop the program. If their authority is less likely to be challenged, either because it is obscured or cloaked in precision, will the formal distribution of power in the organization shift to give preeminence in decision-making to those who comprehend the information system?

2. Stress and the Abstraction of Work

Another feature of computer-based information technology involves the way in which it abstracts most of the work it reorganizes. Unlike industrial work which depended upon machines that were extensions of the human body, computer-mediated work involves little in the way of physical effort. What the airline pilot, the bill collector, the data analyst, and the cold-type operator have in common is that their work consists of reading and manipulating electronic symbols. Those symbols, the language of the computer, mediate between the worker and the work he or she once performed directly.

This abstraction of work routines is shared by many American workers from those who monitor the continuous automatic processes of an oil refinery to hospital nurses, bank tellers, and engineers. The center of gravity in the workplace has shifted from jobs that require bodily involvement to those that require cerebral involvement. But this increased demand for a particular form of mental effort does not

mean a correlative increase in the degree to which these jobs are interesting, varied, challenging, or promising greater opportunities. A more likely combination is that more jobs will require focused cerebral attention while nevertheless being experienced as boring and routine. We are accustomed to thinking of brain jobs as challenging and rewarding. What will be the effect if a vast range of jobs are characterized by abstraction, focused attention, and routinization?

Some early reports are beginning to emerge regarding the stress built into such routine computer-mediated jobs. Swedish researchers are finding that office workers who spend most of their day at visual display units show significantly more physiological symptoms of stress, including high blood pressure and high stress hormone levels, when compared to employees who do not interact continuously with the computer system. (2)

Bill collectors working with an automated collections system also spend their days in front of visual display units. When they worked manually, they had to consult various files and spend considerable amounts of time on the telephone. The computer now provides them with all the information they need. This means they need hardly move away from the screen during the entire day. Though they still spend

time on the telephone, the system is programmed so that accounts pop up continuously during the day according to a programmed scoring system. This means that telephone time per account is kept to a minimum. The overall effect of this change in their working procedures is close attention to a screen full of information during the eight-hour work day. They must read and process information continuously, while the work itself is experienced as routine. The bill collectors interviewed complained of mental strain, fatigue, eye problems, and a variety of physical stress symptoms. One collector who had experience with the prior manual system described the difference this way: "The computer means work is more intense, though you might have accomplished something faster manually. It's as if they want us to become extensions of the computer. You don't need a memory and you don't need to think, but you do need a clear head."

Beyond a consideration of jobs that are marked by this curious combination of abstraction and routinization--what of the process of abstraction itself? How much do we understand about the unique demands that computer-induced work abstraction make upon people at any occupational level? Some of the tentative speculations that emerge on the basis of early interview data suggest that abstraction may be a significant source of stress.

There are two aspects of abstraction that emerge frequently in discussions with employees in different occupations. One aspect involves the invisibility of many features of work when it becomes computer-mediated. Employees note that their work involves manipulating symbols, but what goes on "behind the screen" is lost to view. For example, a linotype operator had this to say: "I used to see the line of type as soon as it was produced. Now I type into the terminal. I don't know where those letters go or what happens to them. I don't know what the print will look like. I guess somewhere they're printing a paper." A bill collector put it this way: "People lose their temper faster with the tubes. The person is just a number. Somehow when you could see all of your account cards in front of you and write down information, it didn't seem that way. You felt you knew your people, your accounts."

Invisibility as a feature of the abstraction of work can affect professionals as well. The regional auditor for a bank now receives financial information on-line from near-by branches. He no longer need travel to the branches, talk with people, and examine books. "In some ways it's quicker to control things, but it's more difficult to define what you want. Since there is nothing before you but numbers, more imagination is required. You have to build up in your mind the way the

system works; there are no guidelines. The job has become very abstract. I may be auditing, but I don't feel like I'm auditing." Does this quality of abstraction affect people's understanding of the work itself? One bank manager had this to say: "Now you make an input and its gone. People become more technical and sophisticated, but they have an inferior understanding of the banking business. New people have no idea of the manual procedures so they never see or understand the processes. People start creating programs that don't necessarily reflect the spirit of the operation."

A corollary of the invisibility of work is its intangibility. Generally, when work becomes computer-mediated it no longer offers physical access to the object of work processes. For example, nurses monitor patient information from terminals instead of visiting patients; newspaper workers like Nellie Weymouth can no longer touch a plate of type; bill collectors no longer handle account cards. If we consider that human beings are tool-users and relate to the world though being able to touch it and act upon it, then the potential significance of intangibility as a feature of computer-mediated work swims into sharper focus. For example, in a branch of one bank, an on-line computer system had been installed for updating information on current accounts. Instead of making out tickets that were sent on to a computer center to be taped

and processed, operators entered data directly into terminals and account information was immediately changed. Despite top management's persuasions to the contrary, the branch operations people insisted on continuing to make up tickets. When asked why, their first response was that they needed a backup system. Further discussion led to the following statement from the operations manager: "You need something you can put your hands on. How else can we be sure the system is correct?" Perhaps Gerry Alvarez, the bill collector, summed it up best: "It's as if - if you can't touch it, you don't really have it. You can't control your work because you can't see it and you can't touch it. It's much harder now that you can't put your hands on things."

As work activities are abstracted, their meaning is also altered. It is easy to find meaning in your job if you are a nurse interacting with patients, but what happens when you are expected to monitor patient information from a video screen? The meaning of the job is thinner, less accessible. As more jobs become subject to this "thinning out" of meaning, will work become less important in peoples' lives, or will there be a new response that challenges employers to provide more meaningful jobs?

3. Management Style, Employee Relations, and Information Technology

Computer systems that are designed according to traditional negative assumptions about human motivation are likely to exacerbate whatever underlying organizational problems already exist. For example, the system that automated collections activities was designed to substitute the computer for human judgment as much as possible. This increases the substitution of labor while trivializing most of the collectors' activities. When managers were asked why the system was designed that way the response was, "we tried to put Bill Smith's brains into the computer." Bill Smith had managed collections for thirty years. While he knew more about the collections process than anyone else, he also believed that "people don't want to work anymore. People think that today's society owes them something. They come to their jobs, but they are not working." This attitude was designed into the system along with his specific knowledge about the job.

The design of an information system--especially where office production activities are concerned--can communicate a management style in other ways. For example, information technology can assimilate many ordinary supervisory functions. The dreams of industrial engineers to create a perfectly timed and rationalized set of activities have always been only imperfectly realized. Face-to-face

supervision can only occur on a partial basis, and employees usually find ways to pace their own activities so that standards can be met at a reasonable pace. But the computerization of work can build the industrial engineer's presence into all real-time activities. Work accomplished through the medium of video terminals or other intelligent equipment can be recorded on a second-by-second basis. Printouts or other immediate forms of visual access to employee output are available to supervisors and managers, thus limiting their dependence on face-to-face supervision but increasing the amount of surveillance that is possible. In some cases this monitoring capability is an explicit management objective. In other cases, it is a feature of the new technical capabilities whose quality of work life consequences have not been sufficiently considered.

The immediacy of access to information and consequent increase in the volume of transactions or operations that can occur also has the effect of compressing time and altering the rhythm of work. While people were once satisfied if the response from a computer system was forthcoming in twenty-four hours, those who work with them are now impatient if information takes more than five seconds to appear. For clerical workers who find their workload increasing with the introduction of computer technology, system failures or slow response times are considered unjust and are met with anxiety. Their output now depends on the timely and reliable functioning of the system.

These new time pressures extend up and down the managerial ladder. Once a manager becomes accustomed to receiving in two hours a report that once took two days to compile, any delay is considered intolerable. This speed of access, retrieval, and information processing is the key to improving the productivity of the office. It is also transforming the social life of the workplace, for the increased workload and rapid turnaround made possible by this compression of time means that work can become more pressured and demanding once it has been reorganized by "labor saving" automation.

Managers concerned with employee satisfaction may find that the conversion to computer-based work procedures can have a profound, and often unintended, effect on the quality of social life at the workplace. For example, employees in the commercial credit office of one bank complained of the isolation demanded by the new computer-mediated work procedures. A video display unit replaced coworkers as the principal focus of interaction. Instead of approaching a supervisor or fellow employee for information or clarification, it was now only necessary to inquire into the terminal for what you wanted to know. Intended to make employees feel more professional with their own "private" place of business, the design of the workstation enforced a sense of isolation and fragmented the local social network so essential to a humane workplace.

Where employees are already unionized, growing militancy toward these forms of hidden computer supervision has already forced some managers to rethink the design of their computer systems. For example, in the Volvo plant in Kalmar, Sweden, designed to enhance the quality of work life, a computer system was installed to monitor assembly operations. The computer was programmed to flash a red light signalling a quality-control problem. The workers protested the red light, insisting that the supervisory function be returned to a foreman. They preferred to answer to a human being with whom they could interact, negotiate, discuss, argue, and explain rather than to a computer whose only means of "communication" is unilateral. (3)

Workers in the Bell system have complained about being strictly monitored by computer technology. Employees reacted against what they see as the erosion of the old "Ma Bell" familial culture and organized a Job Pressures Day to protest the oversupervision, stress, and discipline imposed in large measure by the computer system. The Communications Workers of America (CWA) claim that the stress produced by continual computer surveillance represents a qualitatively new kind of workplace problem and will require new labor strategies. In recent contract negotiations between AT&T and the CWA, a new quality of work life agreement establishes labor-management committees to discuss technological change.

In general, these issues are likely to affect collective bargaining by increasing the territory in which formal legally binding agreements become necessary. For example, manufacturing workers could always count on being able to negotiate with foremen for a certain amount of flexibility on the job. Assemblyline workers might agree to a heightened pace in the morning in return for a more relaxed pace during the afternoon; or it might be possible to speed up and produce the quota in forty-five minutes, saving ten minutes in which to drink coffee and relax. Such informal arrangements do not detract from actual production but serve to humanize the job and create some sense of control over the work tasks. When work activities are monitored and controlled by the computer, such casual arrangements become impossible. Supervisors in the office or foremen on the shop floor are as subject to the computer as are their subordinates.

A likely result of these developments is that formal arrangements will be demanded as a part of collective bargaining agreements where informal understanding once sufficed. This will extend the legitimate territory of collective bargaining and increase the personnel necessary to enforce such contracts. As more office and professional jobs are made subject to the changes entailed by computer technology, people who valued white collar jobs because of the more humane working

conditions they offered (in which individual productivity is imperfectly measured) will experience automation-induced pressures similar to those that symbolized the worst of industrial work. Unless attention is given to the psychological dimensions of computer-mediated work, individuals are likely to channel their energy into various forms of resistance--not merely resistance to change, but resistance to the substantive differences they experience on the job.

Where workers are not organized, their responses to the built-in pressures of computer surveillance and increased time pressures have fewer constructive outlets. If they cannot register their protest as a grievance, they will tend instead to withdraw their concern from the quality of their work or seek covert ways in which to sabotage work activities. Their discontent and feelings of powerlessness could hasten the unionization of the white collar labor force. An office worker in a large insurance company articulated her frustration and sense of hopelessness this way: "I used to love my work but now I come in with a defeatist attitude. The computer has made everything impersonal. You have to deal with it every day. You cannot win it, you cannot beat it, you can't get ahead with it. It's just an inanimate object that stands on your desk and you have to fight it every single day. And the tube is gonna tally what you've worked every minute. I like to feel that I have a chance but with the tubes you do not have a chance."

4. Management and the Nature of Organizations

As computer-based information technology presents important challenges to the traditional psychology of work, it holds the potential for changing some fundamental definitions of management and organization. The industrial organization as a collective enterprise came into existence when it was necessary to bring people together around a central energy source that fueled the means of production. When the means of production becomes dependent on electronic technology and information flows, it is no longer inevitable that labor be collective. New forms of organizational arrangements will become possible as work can be performed in the home or on the road--as long as a terminal and communications link are available. At the same time, electronic technology, in the form of computer conferencing and electronic mail systems, is altering the traditional structure and function of communication within the organization.

As these developments overtake us, they will make it necessary to rethink basic conceptions of the nature of organization and management. What is an organization if people do not have to come face-to-face in order to accomplish their work? Does the organization itself become an abstraction? What happens to the shared purpose and commitment of members if their face-to-face interaction is reduced? Similarly, how should an "abstract" organization be managed? The tradition of supervision and control that grew up with the industrial enterprise

depends on personal contact. If work can be accomplished remotely, then not only will managers face the prospect of managing people they do not see, but they themselves will be able to accomplish many of their managing activities from afar. Will managing the output replace managing the process, thus freeing more members of the organization to determine for themselves the means of accomplishing their tasks?

At the same time, what it means to "accomplish a task" undergoes a fundamental change. The computer-mediation of work translates many occupational activities (from airline piloting to building cars) into abstract monitoring routines, thus washing away the distinctive features of many job-related skills. This may limit the traditional identification with occupational roles. By increasing the transferability of on-the-job skills, individual loyality and commitment to the organization may be diminished, as non-work activities that provide greater opportunity for individual development, expression, and efficacy become more prominent.

If some of the present trends in the design of computer-mediated work systems continue without a greater awareness of their effects on organizations, it is likely that it will undermine parallel efforts at improving the quality of the workplace. If advanced computer-based systems are designed in ways that simply replicate all of the past features

of industrial work (fragmentation, repetitiveness, low choice, little or no control, traditional theory x assumptions), organizations can look forward to a radical separation between a small managerial elite whose work requires some original thought and the vast majority of job holders whose tasks are computer-mediated and highly rationalized.

* * * * * *

The far-reaching impact of computer-based systems on the quality of work life means that managers will have to consider the human responses likely to be engendered by the design of such systems. A natural step would be to invent mechanisms that open up such design questions to the participation of those groups whose work will be most affected by the conversion to computer-mediated procedures. In those cases where potentially negative effects of the new systems seem to be unavoidable, managers will want to give some thought to the kinds of arrangements and opportunities that can be introduced to compensate for the effects of the computer system. This may take the form of new training opportunities and reward systems, educational interventions, more explicit and accessible career ladders, or developing forms of participation that give employees a greater say in other decisions that affect how their work is organized and controlled.

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